Enduring Freedom Combat Assessment Team

M&S Support to MARCENT during Operation IRAQI FREEDOM:

Briefing to USMC M&S Symposium
4 November 2003

UNCLASSIFI

Outline of Brief

- EFCAT & OIF Background
- Analytical Support To MARCENT
- Lessons Learned on M&S Support to the Operating Forces

Background

- Mission/Organization
- Customers
- Products

Mission

Mission Statement

Support CMC's execution of his Title X responsibilities by collecting and developing relevant information and data; conducting assessments and analyses; preparing topical and summary reports and documentation relating to USMC participation in OPLAN 1003V and *Operation ENDURING FREEDOM;* and provide support to operational commanders by establishing an embedded capability within MARCENT staffs.

- Follow-on to initial OEF collection efforts
- OIF guidance added emphasis on support to Operating Forces/Commanders
- Briefed CMC 12 Feb and deployed on 19 Feb (ALMAR 012-03)
- 28-40+ forward-based and 6 @ Quantico + 10 Contractor

Customers

- CMC – Title 10 Issues (Organize, train, equip, & provide USMC forces)
- Advocates – Feedback on issues under their purview/POM initiatives
- MCCDC/Systems Command/TECOM – Requirements generation/UNS feedback/POM Issues/TTPs
- Operating Forces/Commanders – TTP and equipment issues - accelerate feedback on L/L
- Joint/OSD/Congress – Externally-generated issues (e.g., DSB, Congressional queries, Requests for Information (RFIs)
- Media and external RFIs
- All – Establishment of USMC information archive

Products

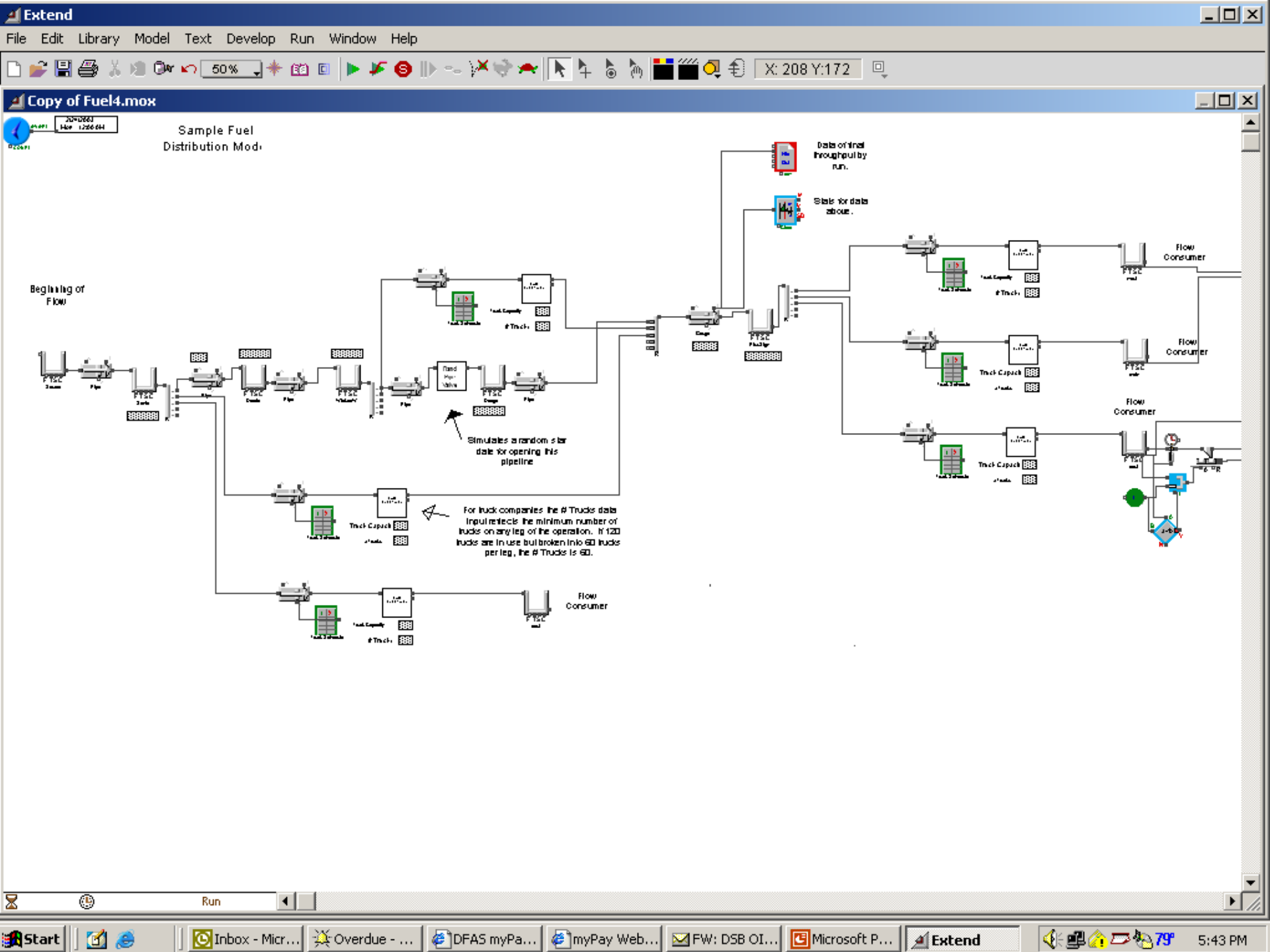
- Title 10 assessments to support CMC, Advocates, P&R, M&RA, etc.
- Provide support to operational commander 
- Integrate lessons learned into EFDS/MCLLS/POM
- Prepare reports, papers, and briefs
- Collect, organize, preserve, and archive information and make available to appropriate organizations

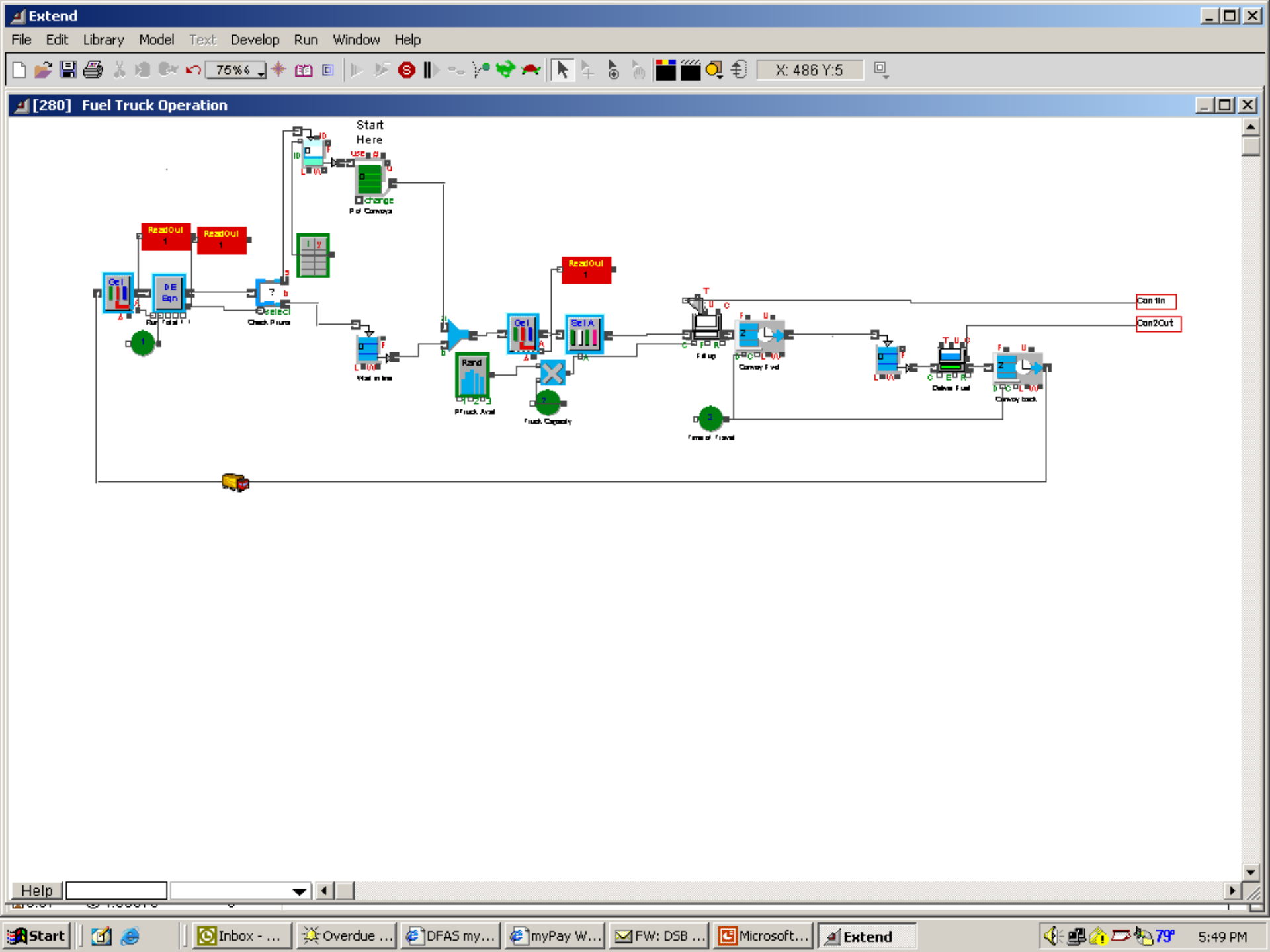
EFCAT Analytical Team

- Co-located in Bahrain with MARCENT
- 2 Military and 1 Civilian GS
- M&S Support
- Excel “help desk”
- Inter-acted with OPTs
- Quick Looks for the G-4/G-5
- Reach-back for MSC embeds/analysts

Outline of Brief

- EFCAT Background
- Analytical Support To MARCENT
  - Fuel Distribution Modeling
  - FARP Modeling
  - R3/ATF Backload Modeling
- Lessons Learned on M&S Support to the Operating Forces


Extend
File Edit Library Model Text Develop Run Window Help
50%
X: 208 Y:172
Copy of Fuel4.mox
Sample Fuel Distribution Mod
Beginning of Flow
Data of final throughput by run.
Stats for data above.
Flow Consumer
Flow Consumer
Flow Consumer
Flow Consumer
Simulates a random start date for opening this pipeline
For truck companies the # Trucks data input reflects the minimum number of trucks on any leg of the operation. If 120 trucks are in use but broken into 60 trucks per leg, the # Trucks is 60.
Run
Start
Inbox - Micr...
Overdue - ...
DFAS myPa...
myPay Web...
FW: DSB OI...
Microsoft P...
Extend
79°
5:43 PM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75%
X: 486 Y:5
[280] Fuel Truck Operation
Start Here
ReadOut 1
ReadOut 1
ReadOut 1
Con1In
Con2Out
Help
Start
Inbox - ...
Overdue ...
DFAS my...
myPay W...
FW: DSB ...
Microsoft...
Extend
79°
5:49 PM

General Fuel Truck Model - provides throughput as a function of distance

Distance, source to combat unit:	**200**	<=Input
Number of 5K Fuel Trucks:	**131**	<=Input
Daily throughput(Kgal/day):	**368.4375**	<=Output

Input Cell
Calculation Cell
Output Cell

1. Units: Kgal, hours, miles, unless otherwise specified.
2. Assumes all truck types are spreadloaded over the various legs and throughput goes unimpeded from source to using unit.
3. Enter input parameters in tan cells.
4. Heuristic chooses best of minimum number legs or +1.

Data

TruckCap	Num	MvtRate	Max leg	OpAvail	PrepTime	Turnover	ShutDown	MinDnTime	MsnDist
5	131	20	90	75.00%	1	1	0	0	200

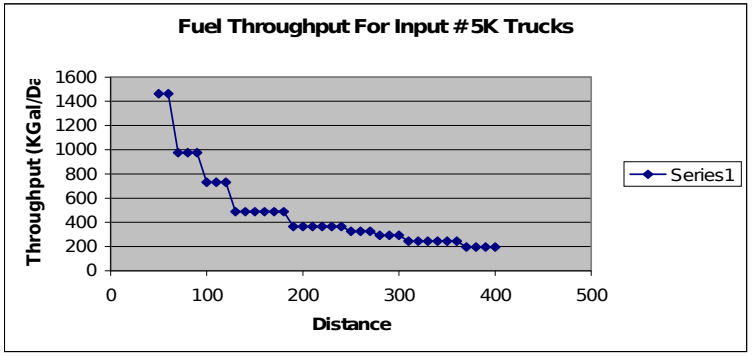
Calculations

NumLegs	NumLegs+	LengthLeg	LengthLeg+	1_TripTime	1_TripTime+	#Trips/Day	#Trips/Day+	Trucks/leg	Trucks/leg+	Throughput
3	4	66.666667	50	8.66666667	7	2	3	43.66666667	32.75	368.4375

Two-Way Variable Table of Throughput as a Function of Distance and Number of Trucks

	DISTANCE (Miles)														
Trucks	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190
10	112.5	112.5	75	75	75	56.25	56.25	56.25	37.5	37.5	37.5	37.5	37.5	37.5	28.125
20	225	225	150	150	150	112.5	112.5	112.5	75	75	75	75	75	75	56.25
30	337.5	337.5	225	225	225	168.75	168.75	168.75	112.5	112.5	112.5	112.5	112.5	112.5	84.375
40	450	450	300	300	300	225	225	225	150	150	150	150	150	150	112.5
50	562.5	562.5	375	375	375	281.25	281.25	281.25	187.5	187.5	187.5	187.5	187.5	187.5	140.625
60	675	675	450	450	450	337.5	337.5	337.5	225	225	225	225	225	225	168.75
70	787.5	787.5	525	525	525	393.75	393.75	393.75	262.5	262.5	262.5	262.5	262.5	262.5	196.875
80	900	900	600	600	600	450	450	450	300	300	300	300	300	300	225
90	1012.5	1012.5	675	675	675	506.25	506.25	506.25	337.5	337.5	337.5	337.5	337.5	337.5	253.125
100	1125	1125	750	750	750	562.5	562.5	562.5	375	375	375	375	375	375	281.25
110	1237.5	1237.5	825	825	825	618.75	618.75	618.75	412.5	412.5	412.5	412.5	412.5	412.5	309.375
120	1350	1350	900	900	900	675	675	675	450	450	450	450	450	450	337.5
130	1462.5	1462.5	975	975	975	731.25	731.25	731.25	487.5	487.5	487.5	487.5	487.5	487.5	365.625
140	1575	1575	1050	1050	1050	787.5	787.5	787.5	525	525	525	525	525	525	393.75
150	1687.5	1687.5	1125	1125	1125	843.75	843.75	843.75	562.5	562.5	562.5	562.5	562.5	562.5	421.875
160	1800	1800	1200	1200	1200	900	900	900	600	600	600	600	600	600	450
170	1912.5	1912.5	1275	1275	1275	956.25	956.25	956.25	637.5	637.5	637.5	637.5	637.5	637.5	478.125
180	2025	2025	1350	1350	1350	1012.5	1012.5	1012.5	675	675	675	675	675	675	506.25
190	2137.5	2137.5	1425	1425	1425	1068.75	1068.75	1068.75	712.5	712.5	712.5	712.5	712.5	712.5	534.375
200	2250	2250	1500	1500	1500	1125	1125	1125	750	750	750	750	750	750	562.5

#Trucks	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190
131	1462.5	1462.5	975	975	975	731.25	731.25	731.25	487.5	487.5	487.5	487.5	487.5	487.5	365.625



Number of Trucks: 131

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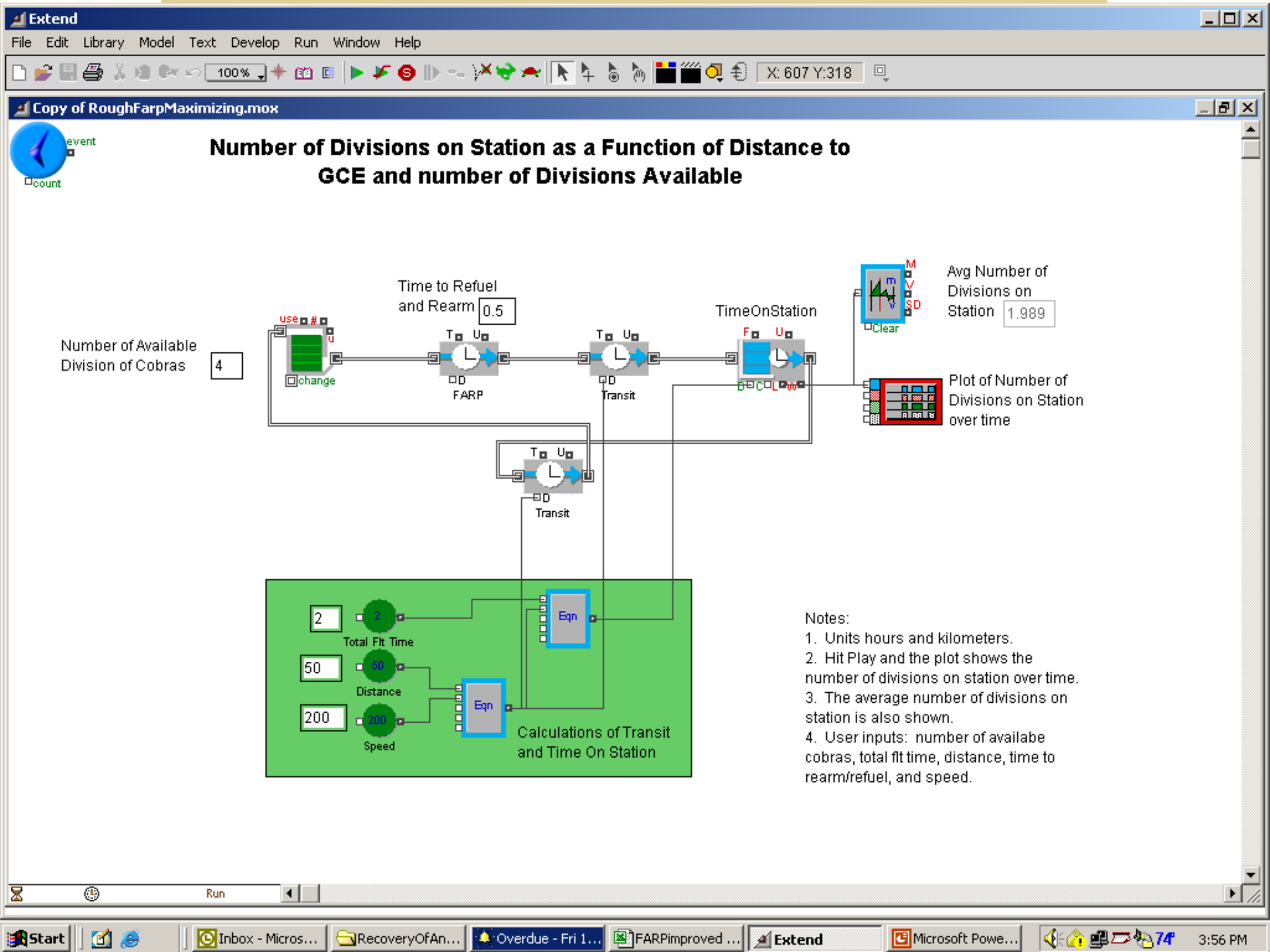
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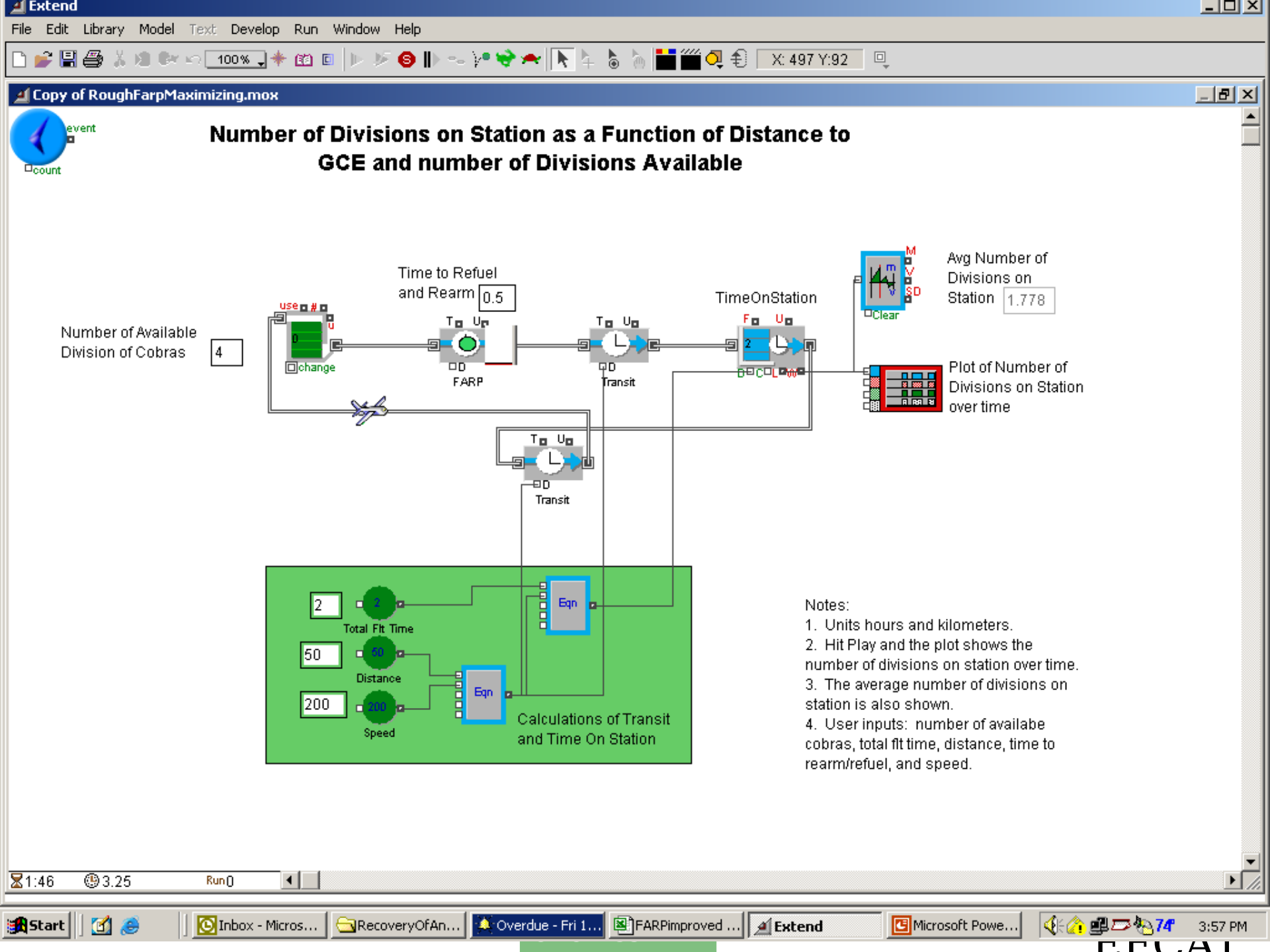
File Edit Library Model Text Develop Run Window Help
100%
X: 607 Y:318
Copy of RoughFarpMaximizing.mox
event
count
Number of Divisions on Station as a Function of Distance to GCE and number of Divisions Available
Number of Available Division of Cobras
4
Time to Refuel and Rearm
0.5
use
#
change
FARP
Transit
TimeOnStation
Clear
Avg Number of Divisions on Station
1.989
Plot of Number of Divisions on Station over time
Transit
2
Total Flt Time
50
Distance
200
Speed
Eqn
Eqn
Calculations of Transit and Time On Station
Notes:
1. Units hours and kilometers.
2. Hit Play and the plot shows the number of divisions on station over time.
3. The average number of divisions on station is also shown.
4. User inputs: number of availabe cobras, total flt time, distance, time to rearm/refuel, and speed.
Run
Start
Inbox - Micros...
RecoveryOfAn...
Overdue - Fri 1...
FARPimproved ...
Extend
Microsoft Powe...
74°
3:56 PM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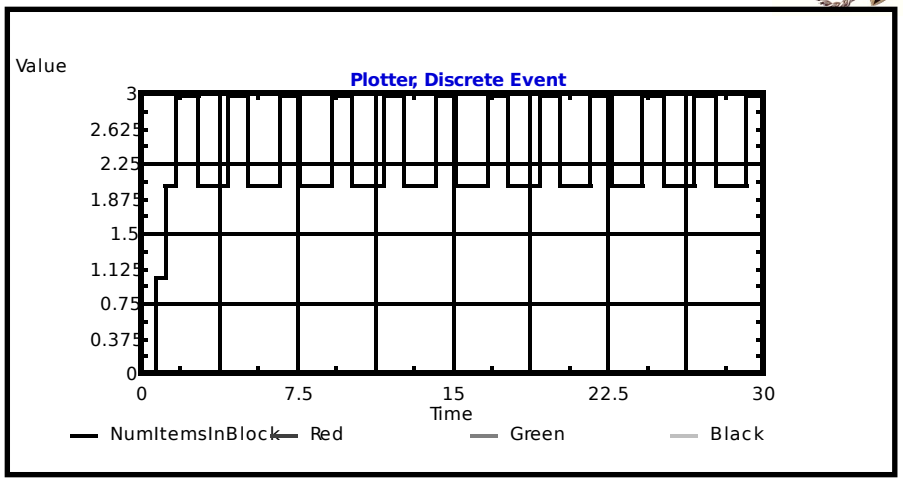
X: 497 Y:92
Copy of RoughFarpMaximizing.mox
event
count
Number of Divisions on Station as a Function of Distance to GCE and number of Divisions Available
Number of Available Division of Cobras
4
use
#
change
Time to Refuel and Rearm
0.5
FARP
Transit
TimeOnStation
Clear
Avg Number of Divisions on Station
1.778
Plot of Number of Divisions on Station over time
Transit
2
Total Flt Time
50
Distance
200
Speed
Eqn
Eqn
Calculations of Transit and Time On Station
Notes:
1. Units hours and kilometers.
2. Hit Play and the plot shows the number of divisions on station over time.
3. The average number of divisions on station is also shown.
4. User inputs: number of availabe cobras, total flt time, distance, time to rearm/refuel, and speed.
1:46
3.25
Run0
Start
Inbox - Micros...
RecoveryOfAn...
Overdue - Fri 1...
FARPimproved ...
Extend
Microsoft Powe...
74°
3:57 PM

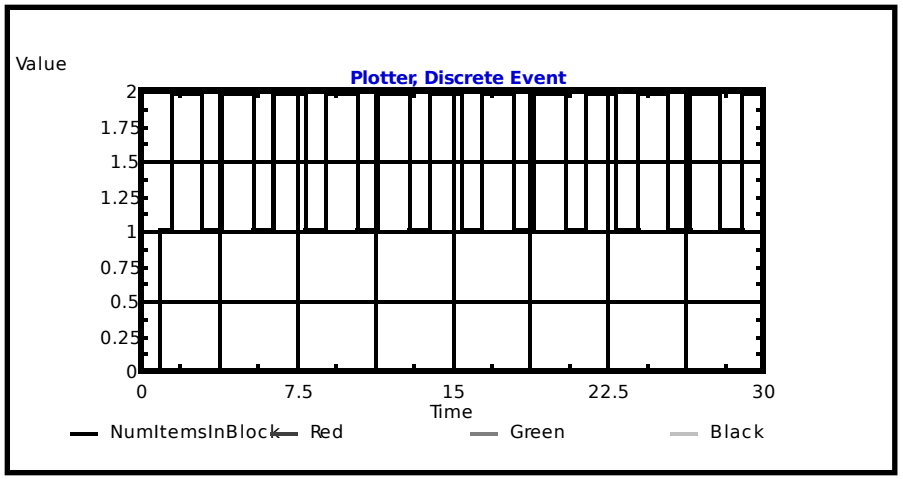
Range 50 miles

Mean:	1.989361702128
Variance:	0.548272706474
Standard deviation:	0.740454391894
Number of Observations:	94



Range 100 miles

Mean:	1.736842105263
Variance:	0.472564389698
Standard deviation:	0.687433189261
Number of Observations:	95



FARP Movement Decision Model

Developed by Majors R.M. Liebe and R.F.A. Woodaman, EFCAT

Assumptions and Definitions:

1. This model determines the right distance from the supported GCE at which the FARP should displace.
2. **All units are hours, km, and km/hr.**
3. It treats as the primary inputs the average rate of advance of the supported GCE, the average speed of the FARP when it moves, and the closest distance from the GCE the FARP will allow itself to approach. Other inputs are discussed below.
4. The model assumes two AH-1 divisions per FARP, alternating TOS and time rearming and refueling in the FARP, and furthermore that there are two FARPs alternatively leapfrogging forward between being emplaced and displacing.
5. It assumes that the typical flight time of the loaded Cobra is 2 hours - user may vary this parameter.
6. TOS is time on station for the Cobras based upon their distance from the supported GCE unit.
7. OST (offstation time) is transit time plus time spent refueling/rearming - assumed 0.5.
7. FARP Downtime is the time the FARP is the sum of time spent packing up, moving, and setting up.
8. FMC time is the time the FARP is full-misson-capable.
9. Two MOEs are present, one from the Cobra Division perspective and one from the FARP.
10. The Cobra divisions want to maximize their time on station relative to their total mission time.
11. The FARP want to maximize their FMC time relative to their DownTime.
12. User needs to employ their Solver add-in to maximize for one MOE while employing a constraint to keep the other MOE above an acceptable level while using the Decision distance as a decision variable. These two MOEs are in opposition. Maximizing FARP effeciency diminished Cobra MOE & vice versa.
13. Maximizing the Cobra MOE while keeping the FARP MOE at at a certain level, keeps the FARPs moving a lot.
14. Maximizing the FARP MOE means that as the GCE gets further away the Cobras will lose TOS.
15. Between the two resulting values of the decision variable is in some sense an efficient space where the FARP is neither moving too much nor the Cobras are providing insufficient TOS in support of the GCE.
16. Useful values for solver: For maximizing Cobra MOE set FARP at MOE at less than or equal to 0.5. For maximizing FARP MOE set Cobra MOE at greater than 0.5.
18. **If user does not choose to employ the Solver add-in, one may treat the Decision variable as a user input and, by varying its value, observe the resulting effect upon the two MOEs.**
19. Making the DecisionVariable too small results in **negative MoveTime**; not enough distance given Packup/Setup times!
20. Second worksheet of this model is a previously developed fuel truck throughput model. Is is included as an aid to the FARP planner in estimating the available throughput via ground fuel truck as a function of the number of available trucks and the distance the trucks must cover from the fuel source.

FARP Movement Decision Model

Input Type		
Input Parameter	10.00	Input Average Rate of Advance for GCE
Input Parameter	30.00	Rate of Advance for FARP
Input Parameter	20.00	Closest Distance Behind GCE for FARP
Input Parameter	20.00	Difference in the two speeds
Input Parameter	2.00	Mission flight time for Cobra Division
Input Parameter	200.00	Speed of Cobras
Input Parameter	0.50	Time it takes for FARP to Packup and displace
Input Parameter	1.00	Time to setup FARP
Input Parameter	0.50	Rearm/Refueling Time
DecisionVariable	45.00	**Distance from GCE triggering move decision**

Color Legend	
User input	
Decision Variable	
Calculation	
MOE	

Cobra MOE Calculation

TotalTransit	TOS	OST	MOE
0.45	1.55	0.95	0.62

<= TOS/(TOS + OST)

FARP MOE Calculation

MoveTime	FMC	MOE
1.50	1.50	0.50

<= FMC/(MoveTime + PackUp + SetUp)

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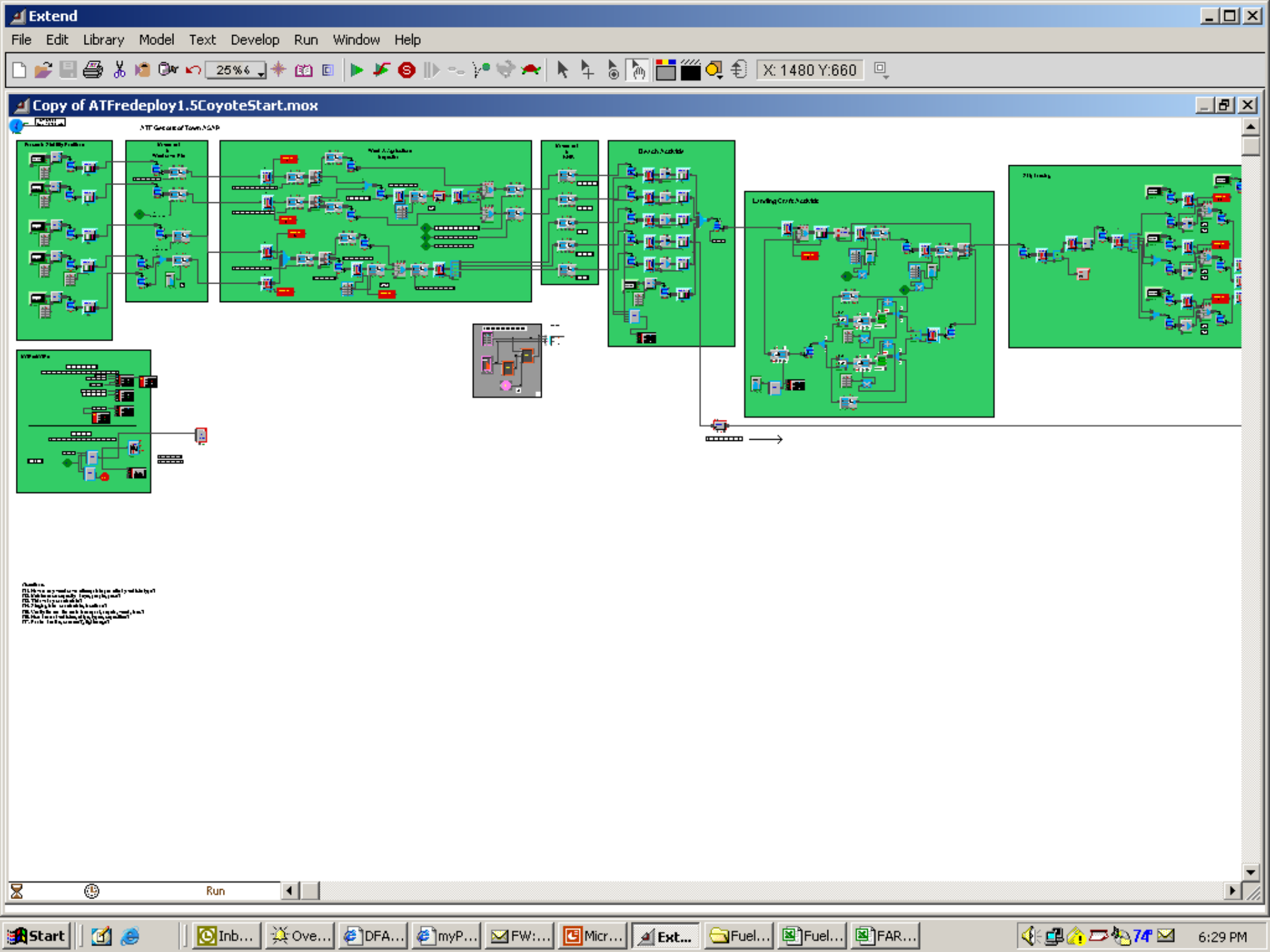
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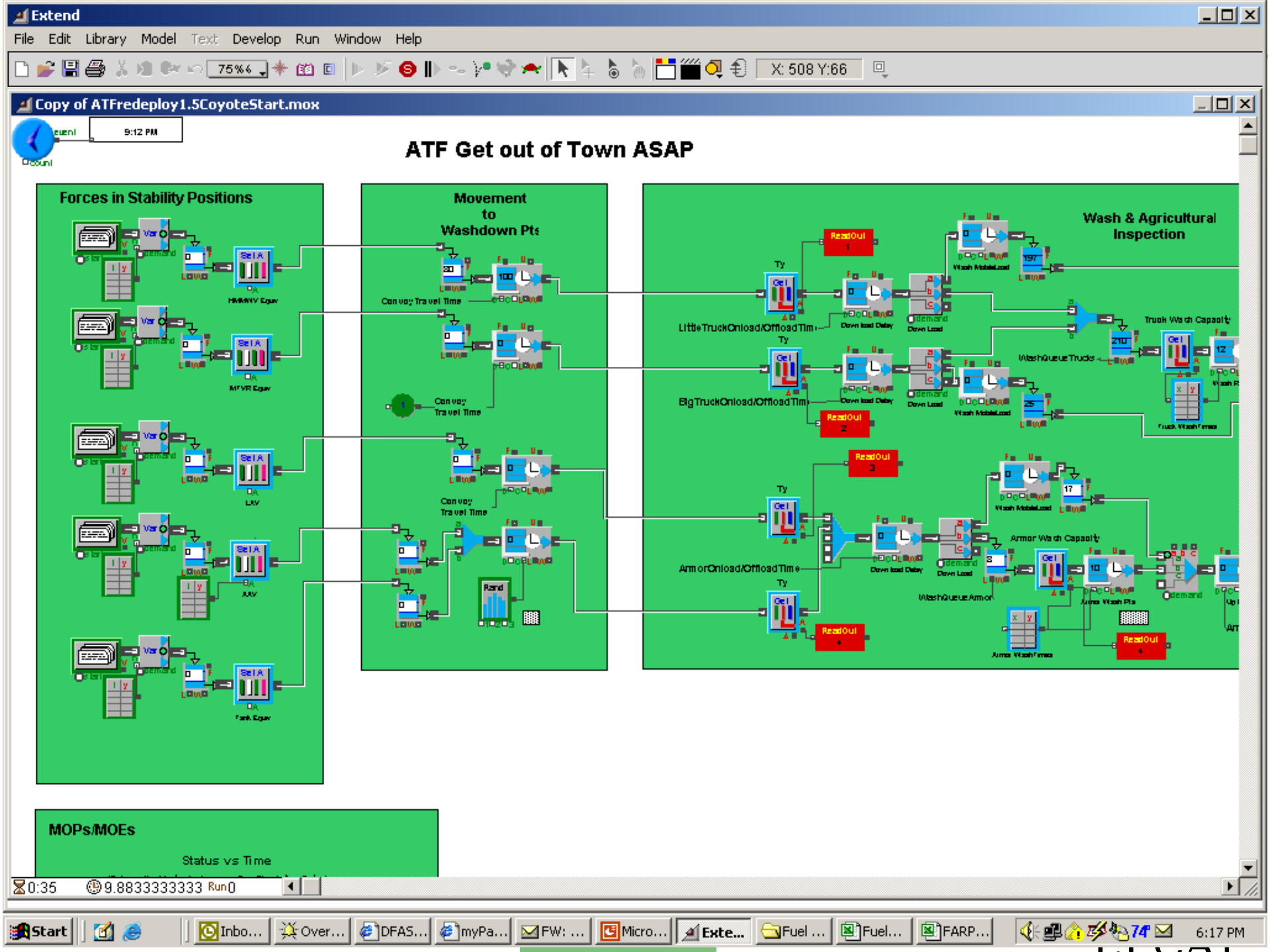
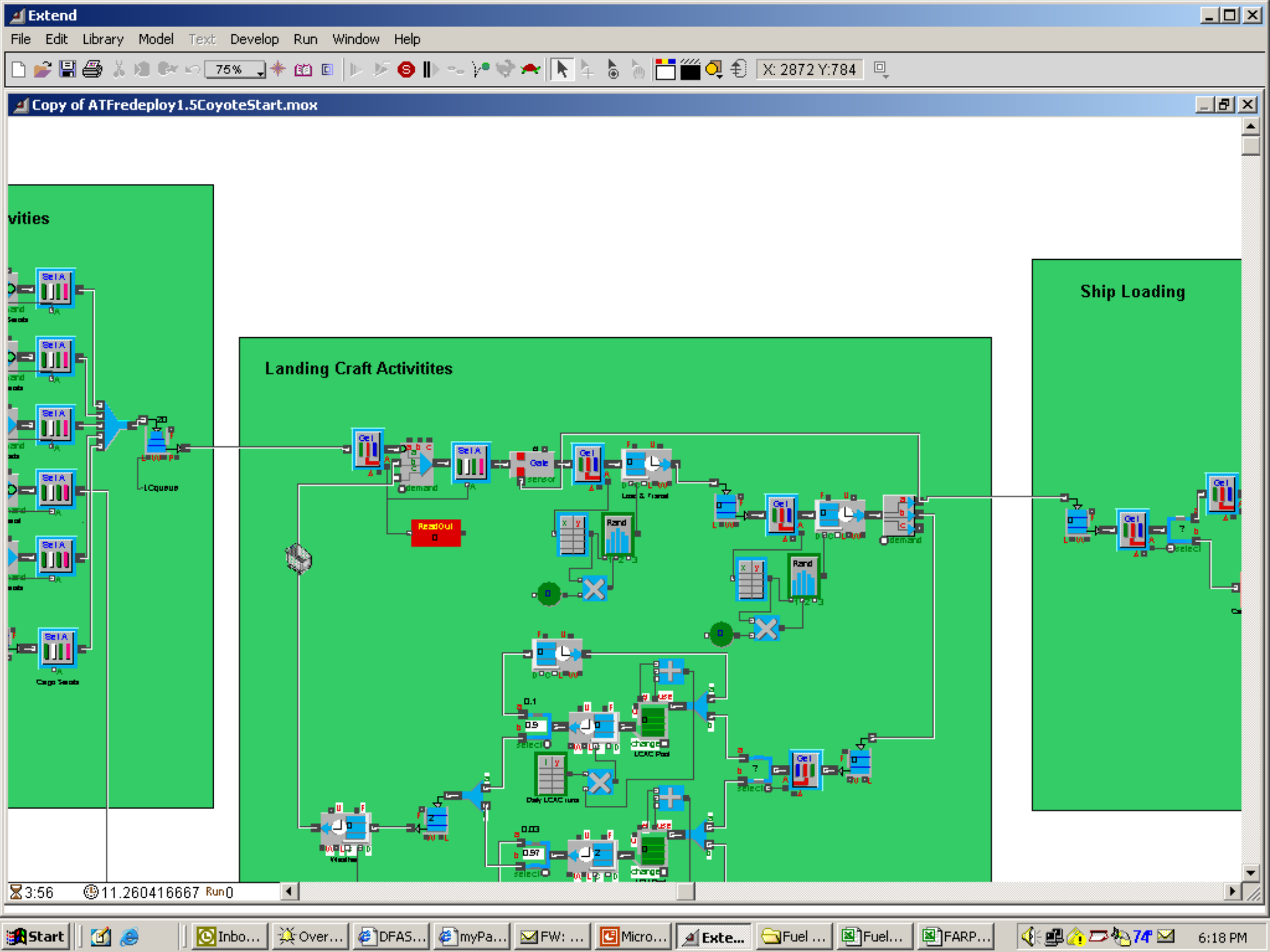
Start
6:29 PM


Extend
File Edit Library Model Text Develop Run Window Help
Copy of ATFredeploy1.5CoyoteStart.mox
ATF Get out of Town ASAP
Forces in Stability Positions
Movement to Washdown Pts
Wash & Agricultural Inspection
Convoy Travel Time
LittleTruckOnload/OffloadTime
BigTruckOnload/OffloadTime
ArmorOnload/OffloadTime
Truck Wash Capacity
Armor Wash Capacity
WashQueueTrucks
WashQueueArmor
MOPs/MOEs
Status vs Time
0:35
9.8833333333 Run()
Start
6:17 PM

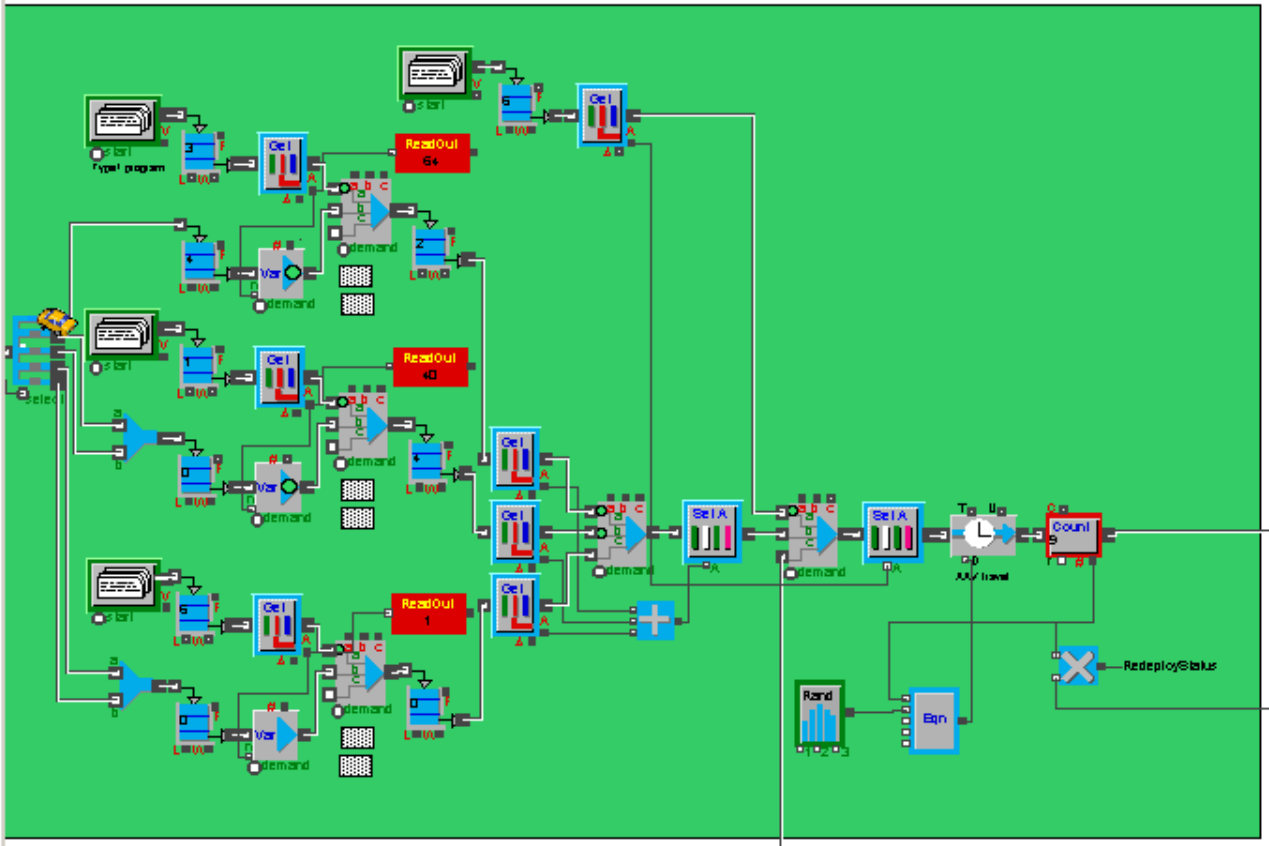

Extend
File Edit Library Model Text Develop Run Window Help
75%
X: 2872 Y:784
Copy of ATFredeploy1.5CoyoteStart.mox
vities
Landing Craft Activitites
Ship Loading
LCqueue
Cargo Seats
demand
ReadOut
Rand
Gate
sensor
Load & Transit
Daily LCAC runs
Washes
3:56
11.260416667
Run 0
Start
Inbo...
Over...
DFAS...
myPa...
FW: ...
Micro...
Exte...
Fuel ...
Fuel...
FARP...
74°
6:18 PM

Extend

File Edit Library Model Text Develop Run Window Help

75% X: 4949 Y:54

Copy of ATFredeploy1.5CoyoteStart.mox



2:53 27.620261312 Run0

Start Inb... Ove... DFA... myP... FW:... Micr... Ext... Fuel... Fuel... FAR... 74° 6:23 PM

Extend

Edit Library Model Text Develop Run Window Help

Notebook - Copy of ATFredeploy1.5CoyoteStart.mox

R3 Model Inputs

Convoy Travel Time 1 hours (from assembly areas to washdown area)

HET travel time 1 hours (includes onload/offload time)

Number of HETs 40

Availability Percentage of HETs 0.75

Mobile Load Offload Time

Little Trucks 0.5 hours

Big Trucks 0.2 hours

Armor 1 hours

Number of Wash Racks 14

Number of Wash Points 10 (# used for armor, not mobile loads)

Vehicle Wash Time

Little Trucks/Trailers 3 hours

Big Trucks/Trailers 4 hours

LAVs 5 hours

AAVs 12 hours

Tanks 24 hours

Onload + Transit Time

LCACs 0.75 hours

LCUs 1.5 hours

Offload and Stowage Time

vehicles 0.4 hours

cargo 6 hours

Number of LCACs 3 Prob. of Failure (per run) 0.1

Number of LCUs 2 Prob. of Failure (per run) 0.03

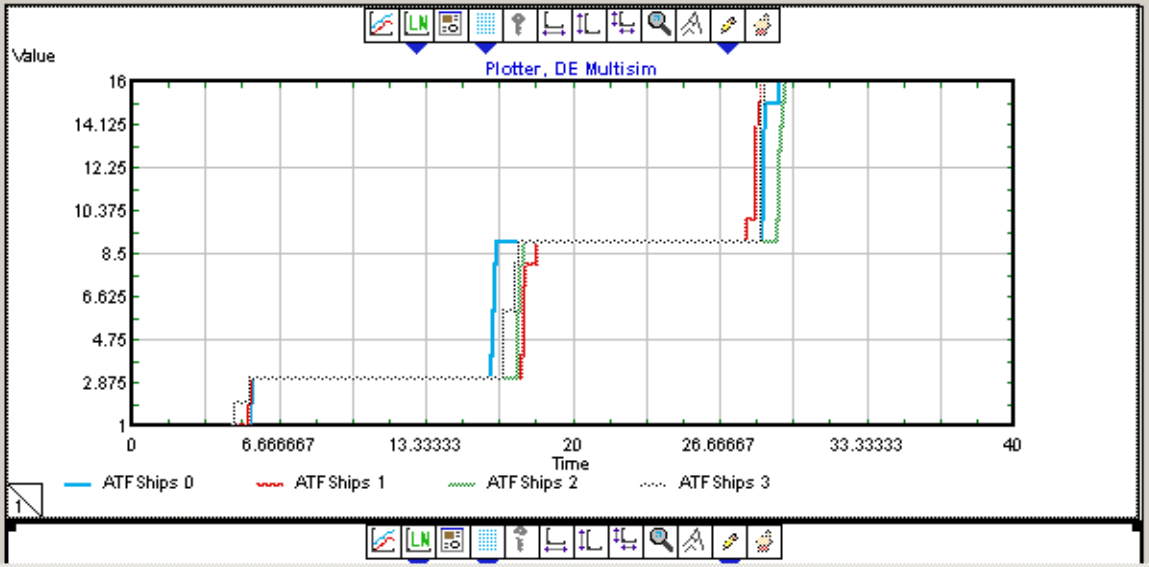
Number per LCAC/LCU

Little Trucks 8 LAVs 4

Big Trucks 4 Tanks 1

Run Statistics

Mean:	29.13127863608
Variance:	0.55869282264
Standard deviation:	0.747457572468
Number of Observations:	30



Start Inbox -... Overdu... DFAS ... myPay ... FW: DS... Microso... Extend Fuel M... Microso... 79° 6:00 PM

Extend

File Edit Library Model Text Develop Run Window Help

100% X: 495 Y:186

Notebook - Copy of ATFredeploy1.5CoyoteStart.mox

Armor 1 hours

Number of Wash Racks 14

Number of Wash Points 10 (# used for armor, not mobile loads)

Number per LCAC/LCU

Little Trucks 8 LAVs 4

Big Trucks 4 Tanks 1

Vehicle Wash Time

Little Trucks/Trailers 3
Big Trucks/Trailers 4
hours

LAVs 5
AAVs 12
Tanks 24
hours

Run Statistics

Mean:	29.13127863608
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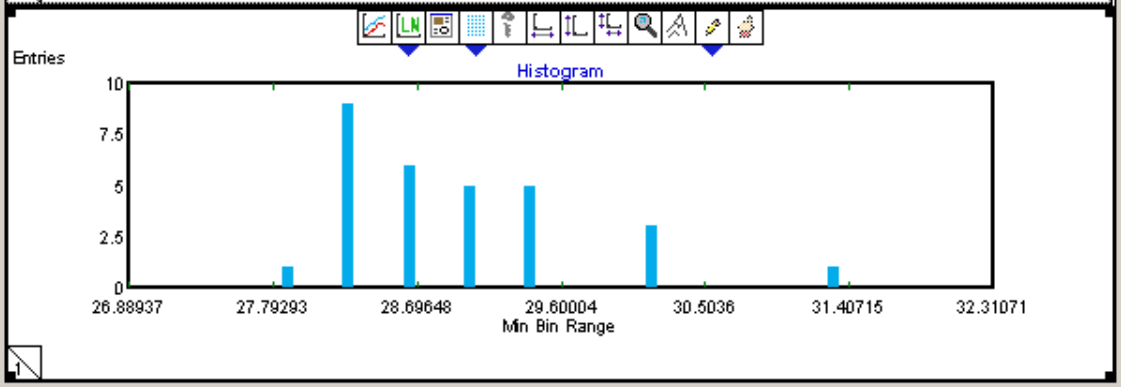

Start Inbox -... Overdu... DFAS ... myPay ... FW: DS... Microso... Extend Fuel M... Microso... 79° 6:01 PM

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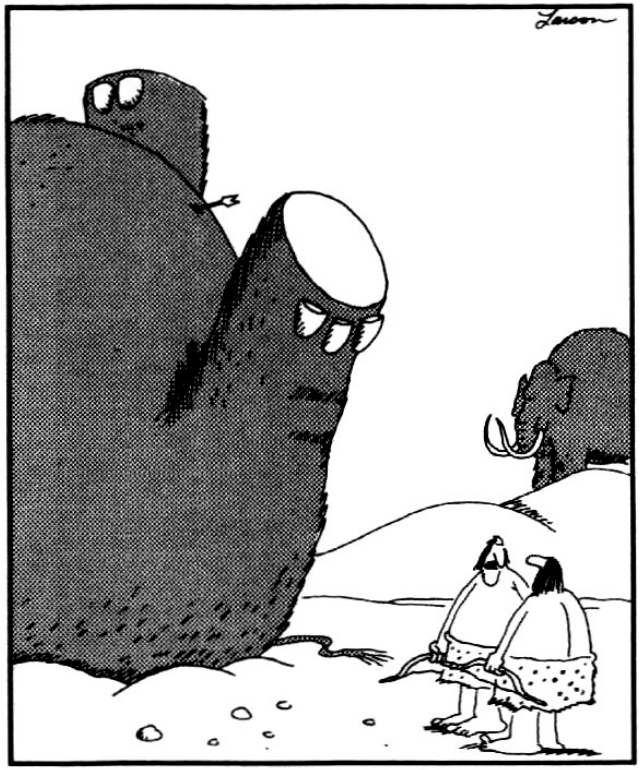
Some Thoughts

- Get involved early if possible
- C.N.A. rep is a conduit – not all are modelers but all appreciate it
- G-4, G-5 are natural users
- Operational credibility is vital

Questions?



"We should write that spot down."

However……

"If the price is too high, the desire is too low

Willis Holmgren